WHAT IS CLAIMED IS:

1. An internal combustion engine comprising:

a combustion chamber in which a predetermined fuel component is burnt;

a reformer that has a reforming catalyst, and that produces a reformed gas which contains the fuel component obtained by reforming a mixture of fuel and air and which supplied to the combustion chamber; and

a control portion that sets an air-fuel ratio of the mixture in the reformer such that a reforming efficiency of the reformer is held within a predetermined range, and that sets an amount of the mixture supplied to the reformer such that an actual torque of the internal combustion engine coincides with a target torque.

2. The internal combustion engine according to claim 1, wherein

the reformer produces a reformed gas containing carbon monoxide and hydrogen by reforming a mixture of hydrocarbon fuel and air, and

the control portion sets a ratio of a number of oxygen atoms in air to a number of carbon atoms in fuel supplied to the reformer approximately within a range of 0.4 to 1.1.

3. The internal combustion engine according to claim 1, wherein

the reformer produces a reformed gas containing carbon monoxide and hydrogen by reforming a mixture of hydrocarbon fuel and air, and

the control portion sets a ratio of a number of oxygen atoms in air to a number of carbon atoms in fuel supplied to the reformer approximately within a range of 0.8 to 1.05.

4. The internal combustion engine according to claim 1, wherein

the control portion sets an amount of air supplied to the reformer such that an actual output torque of the internal combustion engine coincides with a target torque, and sets an amount of fuel supplied to the reformer on the basis of the amount of air and the air-fuel ratio.

5. The internal combustion engine according to claim 4, wherein

the control portion substantially simultaneously sets amounts of air and fuel supplied to the reformer and an amount of air mixed with the reformed gas in accordance with the target torque.

6. The internal combustion engine according to claim 1, further comprising:
an air-supply passage for mixing air with the reformed gas produced by the reformer; and
an adjustment portion that is provided in the air-supply passage and that adjust an amount of air mixed with the reformed gas via the air-supply passage,
wherein the control portion controls the adjustment portion such that an air-fuel ratio of the mixture absorbed into the combustion chamber becomes equal to a desired value.

7. The internal combustion engine according to claim 6, wherein
the control portion substantially simultaneously sets amounts of air and fuel supplied to the reformer and an amount of air mixed with the reformed gas in accordance with the target torque.

8. The internal combustion engine according to claim 1, further comprising:
a temperature detection portion that detects a temperature of the reforming catalyst,
wherein
the control portion estimates the air-fuel ratio of the mixture in the reformer on the basis of the temperature detected by the temperature detection portion.

9. The internal combustion engine according to claim 8, wherein
the control portion corrects the estimated air-fuel ratio in the reformer in accordance with an amount of fuel supplied to the reformer.

10. The internal combustion engine according to claim 8, wherein
the control portion adjusts an amount of fuel supplied to the reformer on the basis of the estimated air-fuel ratio.

11. The internal combustion engine according to claim 1, further comprising:
a temperature detection portion that detects a temperature of the reforming catalyst,
wherein
the control portion adjusts an amount of fuel supplied to the reformer on the basis of the temperature detected by the temperature detection portion.

12. The internal combustion engine according to claim 1, wherein

the control portion sets the air-fuel ratio of the mixture of fuel and air in the reformer larger than the air-fuel ratio corresponding to the reforming efficiency within the predetermined range when the supply of the mixture to the reformer is started.

13. The internal combustion engine according to claim 1, wherein

an air supply amount is reduced prior to stoppage of the supply of fuel to the reformer when the supply of the mixture to the reformer is stopped.

14. The internal combustion engine according to claim 1, further comprising:

an exhaust gas recirculation portion that causes exhaust gas flowing from the combustion chamber to recirculate to the reformer.

15. The internal combustion engine according to claim 14, further comprising:

a temperature detection portion that detects a temperature of the reforming catalyst; and

a control portion that controls the exhaust gas recirculation portion on the basis of the temperature detected by the temperature detection portion.

16. The internal combustion engine according to claim 14, wherein

the exhaust gas recirculation portion increases an amount of exhaust gas recirculated to the reformer when the supply of the mixture to the reformer is stopped.

17. The internal combustion engine according to claim 1, wherein

the reformer has a plurality of reforming reaction portions disposed along a flow direction of the mixture and an oxygen supply portion that supplies oxygen to an oxygen inflow portion set between the reforming reaction portions, and

the air-fuel ratio of the mixture is set smaller than an air-fuel ratio corresponding to the reforming efficiency within the predetermined range in the reforming reaction portion that is disposed upstream of the oxygen inflow portion with respect to the flow direction.

18. The internal combustion engine according to claim 1, wherein

the reformer has a plurality of reforming reaction portions disposed along a flow direction of the mixture and an oxygen supply portion that supplies oxygen to an oxygen inflow portion set between the reforming reaction portions,

the oxygen supply portion supplies oxygen to the oxygen inflow portion of the reformer, and

the air-fuel ratio of the mixture is set larger than the air-fuel ratio corresponding to the reforming efficiency within the predetermined range in the reforming reaction portion that is disposed upstream of the oxygen inflow portion with respect to the flow direction, upon fulfillment of a predetermined operational condition on the reformer.

19. The internal combustion engine according to claim 1, wherein

the reformer has a reforming reaction portion in which the reforming catalyst is disposed,

the reforming reaction portion includes a catalyst small-amount-carriage region at least either at an upstream end thereof or at a downstream end thereof with respect to the flow direction of the mixture, an amount of the reforming catalyst in the catalyst small-amount-carriage region being smaller than an amount of the reforming catalyst in any other region.

20. A method of operating an internal combustion engine comprising a combustion chamber in which a predetermined fuel component is burnt and a reformer that has a reforming catalyst, that reforms a mixture of fuel and air, that contains the fuel component, and that produces a reformed gas supplied to the combustion chamber, comprising the steps of:

setting an air-fuel ratio of the mixture in the reformer such that a reforming efficiency of the reformer is held within a predetermined range; and

setting an amount of the mixture supplied to the reformer such that an actual torque of the internal combustion engine coincides with a target torque.